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(54) HEAT EXCHANGER
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(71) MATSUSHITA SEIKO CO LTD (72) SHINJI OGAWA
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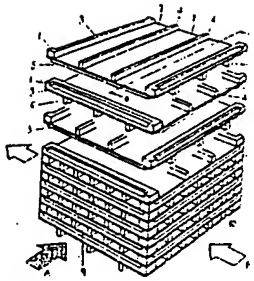
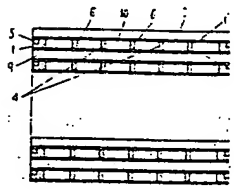
PURPOSE: To certainly and stably form ventilation paths through which primary and secondary air currents flow every other layer by holding mutual heat transfer plates by the spacer ribs provided on the surface of the heat transfer plate and the holding ribs provided on the rear of the adjacent heat transfer plate and fitting shielding ribs in fitting ribs.

CONSTITUTION: Since heat transfer plates 2 are laminated by positioning the holding ribs 6 provided on the surface of the heat transfer plate 2 between the spacer ribs 4 provided on the rear of the adjacent heat transfer plate 2 and fitting the fitting ribs 5 provided on the rear of the heat transfer plate 2 in the step parts 3 of the shielding ribs 1 provided on the surface of the adjacent heat transfer plate 2, the leakage of air from the end parts of the heat transfer plates 2 can be prevented by the fitting of the fitting ribs 5 in the step parts 3 and the heat transfer plates 2 are mutually held by the spacer ribs 4 and the holding ribs 6 to certainly, alternately and stably form ventilation paths 9 allowing a primary air current to flow and ventilation paths 10 allowing a secondary air current to flow and resistance loss can be reduced and a blower can be also miniaturized.





た後での仕上げ切断では間隔板１０１の目がつぶれやすく、切断作業が困難であった。また、この熱交換器１０３を熱交換形換気扇等に使用した場合、間隔板１０１の板厚により、伝熱板１００にて形成される通風路の有効面積が小さくなるため、抵抗損失が大きく、高静圧形の送風機が必要となっていた。また、一般的に全熱交換用として伝熱板１００と間隔板１０１を紙にて製造するがこの場合、熱交換器１０３は非常に壊れやすく、清掃時に間隔板１０２の目をつぶしたり、落下時に破損したりする恐れがあり、また長期間の使用により、伝熱板１００や間隔板１０１が吸湿や乾燥を繰り返して収縮し、１次気流と２次気流が混合しやすくなるなど耐久性に問題があった。

本発明は上記従来の課題を解決するもので、伝熱板表面に設けた複数のリブと、このリブと直交して伝熱板裏面に設けた複数のリブとを、伝熱板をはさんで樹脂にて一体に成型して熱交換板とし、この熱交換板を交互に９０度ずらしながら、かつ伝熱板表面のリブとリブの間に、隣り合う伝熱板裏面のリブを位置させるとともに、伝熱板表面端部に設けたリブと伝熱板裏面端部に設けたリブとを嵌合させながら複数枚積層して熱交換器を形成することにより、製造工程を簡略化して製造コストを低減し、樹脂製リブによって通風路面積を大きくして抵抗損失を小さくするとともに、リブとリブの嵌合によって熱交換器をより強固なものとし、空気もれ等がなく経年変化も少ない、耐久性のある熱交換器を提供することを目的とするものである。

課題を解決するための手段

この課題を解決するために本発明は、正方形の伝熱板表面の向かい合う端部に設けた、角部に伝熱板の一辺より短い階段状の段差を有する、伝熱板の一辺と同寸法の２本の遮へいリブと、上記遮へいリブの間に所定間隔で複数本設けた間隔リブと、上記間隔リブと直交し、上記伝熱板裏面の向かい合う端部に設けた、上記遮へいリブの段差よりわずかに短い２本の嵌合リブと、上記嵌合リブの間に所定間隔で複数本設けた保持リブとを、上記伝熱板を間にはさんで樹脂にて一体に成型して熱交換板とし、この、熱交換板を交互に９０度ずらしながら、かつ熱交換板の伝熱板表面に設けた間隔リブと間隔リブの間に、隣り合う熱交換板の伝熱板裏面に設けた保持リブを位置させるとともに、上記熱交換板の伝熱板表面に設けた遮へいリブの段差に、隣り合う熱交換板の伝熱板裏面に設けた嵌合リブを嵌合させながら複数枚積層した構成としたものである。

作　用

この構成により、伝熱板表面に設けた間隔リブと隣り合う伝熱板裏面に設けた保持リブとが互いの伝熱板を保持しあうとともに遮へいリブと嵌合リブが嵌合することになり、１次気流と２次気流の流れる通風路が一層おきに確実に、かつ安定して形成されることとなる。

実　施　例

以下本発明の一実施例を第１図および第２図にもとづいて説明する。図において、１は正方形の伝熱板２の表面の向かい合う端部に設けた、伝熱板２の一辺と同寸法の２本の遮へいリブで、角部に伝熱板２の一辺より短い階段状の段差３を設けている。４は伝熱板２の表面に設けた間隔リブで、２本の遮へいリブ１の間に所定間隔で複数本設けられている。５は遮へいリブ１の段差３よりわずかに短い２本の嵌合リブで間隔リブ４と直交し、伝熱板２の裏面の向かい合う端部にそれぞれ設けられている。６は伝熱板２の裏面に設けた保持リブで、間隔リブ４と直交し、かつ２本の嵌合リブ５の間に所定間隔で複数本設けられている。７は熱交換板で、伝熱板２をはさみ、伝熱板２の表面に設けた２本の遮へいリブ１と間隔リブ４と、伝熱板２の裏面に設けた２本の嵌合リブ５と保持リブ６とを樹脂にて一体に成型したものである。８は熱交換板７を交互に９０度ずらしながら、かつ伝熱板２の表面に設けた間隔リブ４と間隔リブ４の間に、隣り合う伝熱板２の裏面に設けた保持リブ６を位置させるとともに、伝熱板２の表面に設けた遮へいリブ１の段差３に、隣り合う伝熱板２の裏面に設けた嵌合リブ５を嵌合させな

置させるとともに、伝熱板表
と伝熱板裏面端部に設けたリ
ら複数枚積層して熱交換器を
、製造工程を簡略化して製造
脂製リブによって通風路面積
失を小さくするとともに、リ
って熱交換器をより強固なも
がなく経年変化も少ない、耐
を提供することを目的とする

めの手段

るために本発明は、正方形の
合う端部に設けた、角部に伝
階段状の段差を有する、伝熱
２本の遮へいリブと、上記遮
間隔で複数本設けた間隔リブ
直交し、上記伝熱板裏面の向
た、上記遮へいリブの段差よ
の嵌合リブと、上記嵌合リブ
数本設けた保持リブとを、上

の２本の遮へいリブで、角部
り短い階段状の段差３を設け
２の表面に設けた間隔リブ
ブ１の間に所定間隔で複数本
は遮へいリブ１の段差３より
嵌合リブで間隔リブ４と直交
の向かい合う端部にそれぞれ
は伝熱板２の裏面に設けた保
４と直交し、かつ２本の嵌合
隔で複数本設けられている。
熱板２をはさみ、伝熱板２の
遮へいリブ１と間隔リブ４
に設けた２本の嵌合リブ５と
にて一体に成型したものであ
を交互に９０度ずらしなが
表面に設けた間隔リブ４と間
り合う伝熱板２の裏面に設け
させるとともに、伝熱板２の
リブ１の段差３に、隣り合う
けた嵌合リブ５を嵌合させな

がら複数枚積層した熱交換器で、１次気流を流す通風路９と２次気流を流す通風路１０とを一層おきに形成する構成となっている。

上記構成において、１次気流を矢印Ａのように通風路９に流し、２次気流を矢印Ｂのように通風路１０に流すと、伝熱板２により１次気流と２次気流の熱が交換される。また、熱交換器８の製造工程は、成型機ににによる熱交換板７の一体成型→交互に９０度ずらしながらの積層、の２工程ですむので製造コストが低減でき、また、熱交換板７を成型機で成型するため寸法精度がよく、積層して熱交換器８とした後で仕上げのための切断をする必要がない。また、伝熱板２の裏面に設けた間隔リブ４と間隔リブ４の間に隣り合う伝熱板２の表面に設けた保持リブ６を位置させるとともに、伝熱板２の表面に設けた遮へいリブ１の段差３に隣り合う伝熱板２の裏面に設けた嵌合リブ５を嵌合させながら積層するため、段差３と嵌合リブの嵌合により伝熱板２の端部からの空気もれが防止できるとともに、間隔リブ４と保持リブ６が伝熱

伝熱板裏面端部に設けた嵌合リブを嵌合させながら複数枚積層して熱交換器を形成することにより、製造工程を簡略化して製造コストを低減し、樹脂製リブによって通風路面積を大きくして抵抗損失を小さくするとともに、リブとリブの嵌合によって熱交換器をより強固なものとして空気もれ等を防止し、経年変化を少なくして耐久性を向上することが可能となる等の効果がある。

4．図面の簡単な説明

第１図は本発明の一実施例における熱交換器の斜視図、第２図は第１図のＯ－Ｏ′断面図、第３図は従来の熱交換器の組立状態を示す斜視図、第４図は同熱交換器の完成品の斜視図である。

１……遮へいリブ、２……伝熱板、３……段差、４……間隔リブ、５……嵌合リブ、６……保持リブ、７……熱交換板、８……熱交換器。

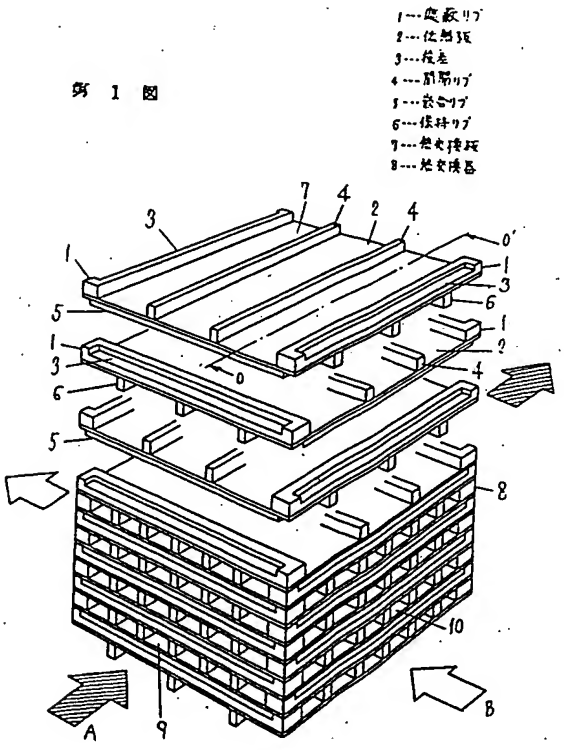
代理人の氏名　弁理士　栗野重孝　ほか１名

板２を保持しあって、１次気流を流す通風路９と２次気流を流す通風路１０とが確実に交互に、かつ安定して形成され、抵抗損失を小さくすることが可能となり、送風機も小さくすることが可能となる。また、遮へいリブ１，間隔リブ４，嵌合リブ５，保持リブ６が樹脂性であるとともに、遮へいリブ１と嵌合リブ５が嵌合しているため、熱交換器８が非常に強固なものとなり、清掃時の目つぶれがなくなり、落下等でも容易に変形することもなく、長期使用に耐えることが可能となる。

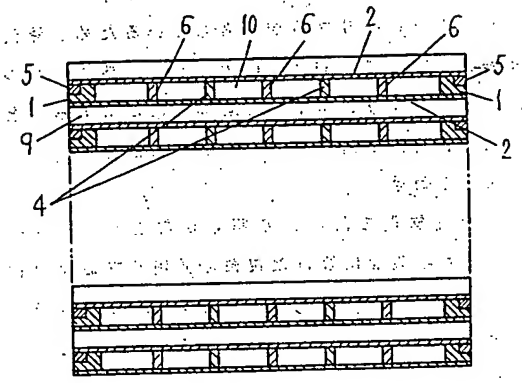
発明の効果

前記実施例の説明より明らかなように本発明は、伝熱板表面に設けた複数の間隔リブおよび遮へいリブと、これらのリブと直交して伝熱板裏面に設けた複数の保持リブおよび嵌合リブとを、伝熱板をはさんで樹脂にて一体に成型して熱交換板とし、この熱交換板を交互に９０度ずらしながら、かつ伝熱板表面の間隔リブと遮へいリブの間に、隣り合う伝熱板裏面の保持リブを位置させるとともに、伝熱板表面端部に設けた遮へいリブと

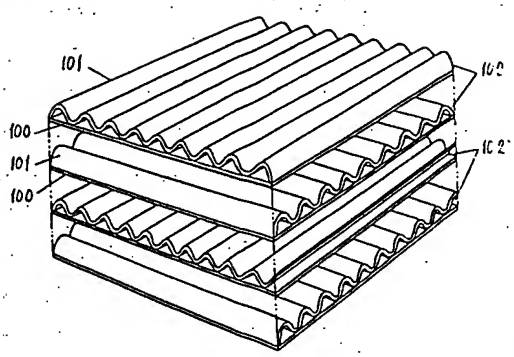
第１図



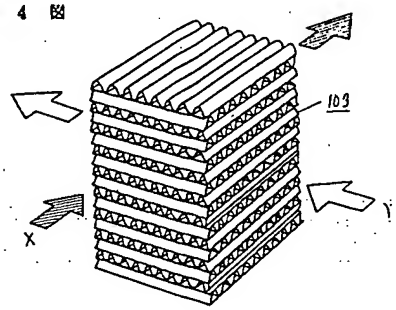
第 2 図

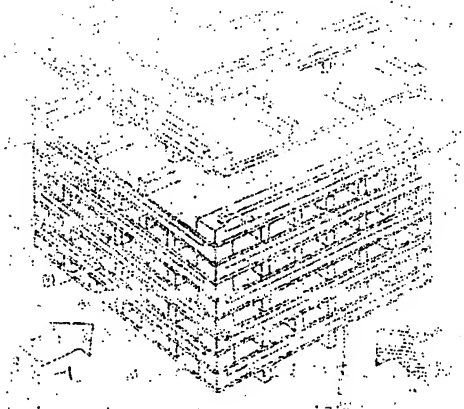


第 3 図



第 4 図





(1) Kokai (Japanese Unexamined Patent Publication) No. 3-286995
Title of the Invention: Heat Exchanger
Publication Date: December 17, 1991
Application No. 2-86589
Filing Date: March 30, 1990
Applicant: Matsushita Precision Works, Co., Ltd.
Inventor: Shinji Ogawa

CLAIM

A heat exchanger, wherein two shield ribs of the same length as one side of a square heat transmission plate and having at a corner thereof a stepped portion shorter than one side of the heat transmission plate are formed along the opposed end portions of the obverse surface of the heat transmission plate, wherein a plurality of spacer ribs are formed at predetermined intervals between the shield ribs, wherein two fitting ribs slightly shorter than the stepped portion of the shield ribs are formed along the opposed end portions of the reverse surface of the heat transmission plate in the direction perpendicular to the spacer ribs, wherein a plurality of holding ribs are formed at predetermined intervals between the fitting ribs, wherein the shield ribs, the spacer ribs, the fitting ribs, the holding ribs and the heat transmission plate are molded into a heat exchange plate of resin, and wherein a plurality of the heat exchange plates are stacked while being displaced by 90 degrees alternately, so that the holding ribs formed on the reverse surface of the heat transmission plate of a heat exchange plate are located between the spacer ribs formed on the obverse surface of the heat transmission plate of an adjacent heat exchange plate, and the fitting ribs formed on the reverse surface of the heat transmission plate of a heat exchange plate are fitted in the stepped portions of the shield ribs formed on the obverse surface of the heat transmission plate of an adjacent heat exchange plate.

3. Detailed Description of the Invention

Industrial Field of Utilization:

The present invention relates to a heat exchanger used for a ventilation fan of a heat exchange type.

Prior Art:

Conventionally, a heat exchanger of this type, as shown in Figs. 3 and 4, is configured of a plurality of heat exchange plates 102, each including a thin heat transmission plate 100 of paper or plastics and a corrugated spacer plate 101 attached to each other, wherein the heat exchange plates 102 are stacked while being displaced alternately by 90 degrees thereby to form a heat exchanger 103 for performing the heat exchange operation between a primary air current X and a secondary air current Y.

Problem to be Solved by the Invention:

The process of fabricating the conventional heat exchanger 103 having the configuration described above comprises the steps of corrugating the spacer plates

101, fabricating each heat exchange plate 102 by attaching the heat transmission plate 100 and the spacer plate 101 to each other, cutting the heat exchange plates 102, stacking the heat exchange plates 102, and finish cutting to complete the heat exchanger 103 of a predetermined size. This process involves a high fabrication cost. Also, the finish cutting after stacking is liable to squash the spaces of the spacer plates 101, which makes the cutting work difficult. In the case where this heat exchanger 103 is used for a ventilation fan of a heat exchange type or the like, the thickness of the spacer plates 101 reduces the effective area of the air paths formed on the heat transmission plates 100, and the resultant increased resistance loss requires a fan of a high static pressure type. Generally, the heat transmission plate 100 and the spacer plate 101 are formed of paper for total heat exchange. In this case, the heater exchanger 103 is easily broken, with the probable result that the spaces of the spacer plate 102 are squashed at the time of cleaning or ruptured by being dropped. Also, after long use, the heat transmission plate 100 and the spacer plate 101 repeatedly absorb moisture or are dried, thereby making the primary air current and the secondary air current liable to mix with each other for a reduced durability.

The present invention is intended to solve these problems of the prior art, and the object thereof is to provide a highly durable heat exchanger comprising a plurality of heat exchange plates each configured of a heat transmission plate, wherein a plurality of ribs are formed on the obverse surface of the heat transmission plate, and a plurality of ribs perpendicular to the ribs on the obverse surface of the heat transmission plate are formed on the reverse surface of the same heat transmission plate, wherein the two types of ribs with the heat transmission plate therebetween are integrally resin molded into a heat exchange plate, and wherein a plurality of the heat exchange plates are stacked while being displaced alternately by 90 degrees so that the ribs on the reverse surface of a given heat transmission plate are located between the ribs on the obverse surface of an adjacent heat transmission plate in staggered fashion, wherein the ribs formed at the end portions of the obverse surface of a given heat transmission plate are fitted on the ribs formed at the end portions of the reverse surface of an adjacent heat transmission plate, thereby stacking a plurality of the heat exchange plates. In this way, the fabrication process is simplified for a reduced fabrication cost, the resin ribs reduces the resistance loss by increasing the area of the air paths, the strength of the heat exchanger is increased by fitting the ribs on each other, while at the same time eliminating the air leakage and reducing secular variations.

Means for Solving the Problems:

In order to solve these problems, according to the invention, there is provided a heat exchanger, wherein two shield ribs of the same length as one side of a square heat transmission plate and having at a corner thereof a stepped portion shorter than one side of the heat transmission plate are formed along the opposed end portions of the obverse surface of the heat transmission plate,

wherein a plurality of spacer ribs are formed at predetermined intervals between the shield ribs, wherein two fitting ribs slightly shorter than the stepped portion of the shield ribs are formed along the opposed end portions of the reverse surface of the heat transmission plate in the direction perpendicular to the spacer ribs, wherein a plurality of holding ribs are formed at predetermined intervals between the fitting ribs, wherein the shield ribs, the spacer ribs, the fitting ribs, the holding ribs and the heat transmission plate are molded into a heat exchange plate of resin, and wherein a plurality of the heat exchange plates are stacked while being displaced by 90 degrees alternately, so that the holding ribs formed on the reverse surface of the heat transmission plate of a heat exchange plate are located between the spacer ribs formed on the obverse surface of the heat transmission plate of an adjacent heat exchange plate, and the fitting ribs formed on the reverse surface of the heat transmission plate of a heat exchange plate are fitted in the stepped portions of the shield ribs formed on the obverse surface of the heat transmission plate of an adjacent heat exchange plate.

Operation:

As the result of this configuration, the spacer ribs arranged on the obverse surface of a heat transmission plate and the holding ribs arranged on the reverse surface of an adjacent heat transmission plate cooperate with each other to hold the heat transmission plates, while at the same time the shield ribs and the fitting ribs are fitted with each other. In this way, air paths for passing the primary air current and the secondary air current are formed positively and stably in alternate layers.

Embodiments:

An embodiment of the invention will be explained below with reference to Figs. 1 and 2. In the drawings, numeral 1 designates two shield ribs of the same size as one side of a square heat transmission plate 2, which shield ribs are arranged at the opposed end portions, respectively, on the obverse surface of the heat transmission plate 2. A stepped portion 3 shorter than one side of the heat transmission plate 2 is formed at a corner of each of the shield ribs. Numeral 4 designates a plurality of spacer ribs arranged on the obverse surface of the heat transmission plate 2, which spacer ribs are arranged at predetermined intervals between the two shield ribs 1. Numeral 5 designates two fitting ribs slightly shorter than the stepped portion 3 of the shield rib 1 and arranged in positions perpendicular to the spacer ribs 4, along the opposed end portions, respectively, on the reverse surface of the heat transmission plate 2. Numeral 6 designates a plurality of holding ribs arranged on the reverse surface of the heat transmission plate 2 in positions perpendicular to the spacer ribs 4, which holding ribs are arranged at predetermined intervals between the two fitting ribs 5. Numeral 7 designates a heat exchange plate of resin formed by integrally molding the heat transmission plate 2, the two shield ribs 1 and the spacer ribs 4 arranged on the obverse surface of the heat transmission plate 2, and the two fitting ribs 5 and the holding ribs 6 arranged on the reverse surface of the heat transmission plate 2.

Numeral 8 designates a heat exchanger comprising a plurality of heat exchange plates 7 stacked by being displaced 90 degrees alternately, so that the holding ribs 6 arranged on the reverse surface of a heat transmission plate 2 are located between the spacer ribs 4 arranged on the obverse surface of an adjacent heat transmission plate 2, while the fitting ribs 5 arranged on the reverse surface of a heat transmission plate 2 are fitted in the stepped portions 3 of the shield ribs 1 arranged on the obverse surface of an adjacent heat transmission plate 2, and an air path 9 for passing the primary air current and an air path 10 for passing the secondary air current are formed in alternate layers.

In the configuration described above, the primary air current is passed through the air paths 9 as indicated by arrow A, and the secondary air current is passed through the air paths 10 as indicated by arrow B. The heat of the primary air current is exchanged with the heat of the secondary air current by the heat transmission plates 2. The heat exchanger 8 can be fabricated only through the two steps of integrally molding the heat exchange plate 7 by a molding machine, and stacking the heat exchange plates 7 while displacing them alternately by 90 degrees. Thus, the fabrication cost can be reduced. Also, since a molding machine is used to mold each heat exchange plate 7, a high dimensional accuracy can be secured. After stacking the heat exchange plates 7 into a heat exchanger 8, therefore, the process of finish cutting is not required. Further, in view of the fact that the holding ribs 6 arranged on the obverse surface of a heat transmission plate 2 are located between the spacer ribs 4 arranged on the reverse surface of an adjacent heat transmission plate 2 and the fitting ribs 5 arranged on the reverse surface of a heat transmission plate 2 are fitted in the stepped portions 3 of the shield ribs 1 arranged on the obverse surface of an adjacent heat transmission plate 2, while stacking the heat transmission plates, the air leakage from the end portions of each heat transmission plate 2 can be prevented by the fitting between the stepped portions 3 and the fitting ribs 5. At the same time, the spacer ribs 4 and the holding ribs 6 cooperate with each other in holding the heat transmission plates 2. Thus, the air paths 9 for passing the primary air current and the air paths 10 for passing the secondary air current are positively and stably formed alternately. In this way, both the resistance loss and the size of the fan can be reduced. Also, since the shield ribs 1, the spacer ribs 4, the fitting ribs 5 and the holding ribs 6 are formed of resin, and the shield ribs 1 and the fitting ribs 5 are fitted with each other, the strength of the heat exchanger 8 is greatly increased. As a result, the spaces are prevented from being squashed at the time of cleaning, and the heat exchanger is not easily broken even if dropped, thereby lengthening the service life thereof.

Effects of the Invention:

As apparent from the foregoing description of an embodiment, according to this invention, there is provided a heat exchanger comprising a plurality of heat transmission plates, each of which includes a plurality of spacer ribs and shield ribs arranged on the obverse surface of each heat transmission plates, and a

plurality of holding ribs and fitting ribs arranged on the reverse surface of an adjacent heat transmission plate in the direction perpendicular to the ribs, wherein the spacer ribs, the shield ribs, the holding ribs, the fitting ribs and the associated heat transmission plate are integrally molded using a resin material thereby to form a heat exchange plate of resin, wherein a plurality of the heat exchange plates are stacked while being displaced alternately by 90 degrees, so that the holding ribs on the reverse surface of each heat transmission plate are located between the spacer ribs and the shield ribs on the obverse surface of an adjacent heat transmission plate, and wherein the shield ribs arranged along the end portions of the obverse surface of each heat transmission plate are fitted with the fitting ribs formed along the end portions of the reverse surface of an adjacent heat transmission plate, thereby forming a heat exchanger. In this way, the fabrication process is simplified for a reduced fabrication cost, and the area of the air paths is increased by the resin ribs with a reduced resistance loss. Also, the fitting between the ribs further increases the strength of the heat exchanger, while at the same time preventing the air leakage. In addition, the variations are reduced, and the durability is improved.

4. Brief Description of the Drawings

Fig. 1 is a perspective view of a heat exchanger according to an embodiment of the invention, Fig. 2 a sectional view taken in line O-O' in Fig. 1, Fig. 3 a perspective view showing the manner in which the conventional heat exchanger is assembled, and Fig. 4 a perspective view of the same heat exchanger in completed form.

1...Shield rib, 2...Heat transmission plate, 3...Stepped portion, 4...Space rib, 5...Fitting rib, 6...Holding rib, 7...Heat exchange plate, 8...Heat exchanger.

Drawing

1...Shield rib
2...Heat transmission plate
3...Stepped portion
4...Space rib
5...Fitting rib
6...Holding rib
7...Heat exchange plate
8...Heat exchanger